

REMARKS

Entry of the above amendments and consideration of the following remarks are respectfully requested. Upon entry of the above amendments, this application will contain claims 16, 20-27 and 31 pending and under consideration.

In this submission, claim 16 has been amended; claims 18 and 28-30 have been canceled; and new claim 31 has been added.

In the latest Office Action, the claims were rejected under 35 USC §103 over So et al. (US 4,760,138, referred to as "So") in view of Bunger et al. (US 5,846,500, referred to as "Bunger"). For the reasons discussed more fully below, it is believed that these rejections are overcome. Consequently, reconsideration of this application leading to withdrawal of all rejections and timely allowance is respectfully requested.

Background

Broadly, the applicants' invention relates to an industrial process for the conversion of "lime" (impure calcium hydroxide) to a pure product of calcium carbonate containing calcium derived from the lime. The invention is applicable particularly to the treatment of waste lime materials (e.g. carbide lime) for the recovery of the calcium in the form of a useful product (e.g. calcium carbonate). The process may therefore be regarded as the "up cycling" of lime. One of the principal inventive steps lies in the solvent chosen to extract calcium from the lime material. This is broadly defined in the application as a polyhydroxy compound of a defined general formula, the preferred example being sorbitol. In practice, an overall process in accordance with the invention for converting the lime to a commercially useful product will comprise the steps of:

- (a) treating the lime with the polyhydroxy compound;
- (b) filtering the solution thus obtained to remove insoluble impurities and leave the calcium in a relative pure solution; and
- (c) treating the "pure" calcium containing solution obtained from step (b) with a "precipitating agent" to produce the commercially useful product.

With regard to step (c) the desired effect is to precipitate calcium carbonate using carbon dioxide as the precipitating agent. In the case the precipitation step will be effected until the

solution is at a pH of about 7 at which point the calcium carbonate copiously precipitates from the solution. This point is relevant to the invention because at pH 7 is discussed below.

Rejections Under 35 USC §103

Claims 16, 18, and 20-29 were rejected under So in view of Bunker. The present invention is directed to a method of obtaining a calcium carbonate salt from a carbide lime waste product. The claimed method includes treating the impure carbide lime with a solution of polyhydroxy compound. Since the starting carbide lime material is impure, this resulting solution includes various insoluble components. The insoluble components are filtered out to provide a clear solution containing the polyhydroxy compound and calcium ions. The resulting solution is then further processed by adding a precipitating agent, carbon dioxide, until the pH of the solution is about 7. This induces calcium carbonate to precipitate from the solution; the precipitated calcium carbonate is then collected.

In contrast, the So reference contemplates preparing a carbonating agent complexed with the carbohydrate that can to be used in medicinal or nutritive supplements, and food applications as a carbonate dioxide carrier for isotonic drinks, whipped cream, cocoa, cappuccino, and the like. (So, col. 3, lines 1-15 and col. 7, lines 39-54.) Consequently, So begins with a highly pure source of calcium and a hydroxide base. So does not require the necessity to filter any insoluble impurities from the impure calcium solution as presently claimed.

So teaches bubbling carbon dioxide through the chilled solution containing calcium and the carbohydrate to form the carbon complex. While forming the complex, the pH of the chilled solution can vary between 7-12, but So also raises the pH to between 9 and 12 to maintain the calcium carbonate/carbohydrate complex in solution. Finally, the calcium carbonate-carbohydrate complex precipitates--at the higher pH-- which is then collected. So's process provides a **calcium carbonate-carbohydrate complex** that can be used in food and medicinal applications and must necessarily be highly pure. Consequently, So begins his process using a highly pure calcium source. So does not need to filter the solution to remove insoluble impurities; and So produces a calcium carbonate-carbohydrate complex and not the calcium carbonate as presently claimed. In particular regarding this last point, since So is directed to isolating the calcium carbonate-carbohydrate complex, So must maintain and treat the calcium

containing solution above pH 7 and keep the solution cold to ensure that the carbon dioxide saturates the solution.

Bunger et al. discloses a method of purifying calcium hydroxide. The procedure described in Bunger et al. dissolves the impure calcium hydroxide in water. The calcium hydroxide is not very soluble in water; consequently, the process uses a highly dilute solution of calcium hydroxide. (Bunger et al., col. 4, lines 7-20.) The resulting solution is then filtered. Dispersing CO₂ through the solution isolates the purified calcium carbonate crystals. Bunger introduces the carbon dioxide in a "proper stoichiometric" ratio, (Bunger, col. 8, lines 1-3); at a high concentration e.g., mixing the CO₂ and Ca(OH)₂ reactants at maximum concentration to produce uniform and small crystals [of calcium carbonate]; (id., col. 7, lines 59-66.); or in amounts so that the pH at the end of the reaction is between about 9.5 and 9.7 (id, col. 10, lines 26-29). However, since Bunger only uses a dilute, impure solution of calcium, and his yields are very low. Thus, Bunger's process is a highly inefficient process that does not lend it self to commercial production of calcium carbonate nor would this process be useful to provide a highly pure food grade calcium carbonate complex.

Firstly, neither reference teaches that the pH of the resulting filtered solution should be adjusted to about 7 to induce precipitation of the calcium carbonate, which can then be collected. It is maintained that the cited references considered either in combination or alone do not disclose or make obvious the claimed invention.

Secondly, the two references should not be combined because to do so would change the basic operation of the invention described in So. So as noted above teaches that a carbonating agent of calcium carbonate-carbohydrate complex can be formed by reacting a carbohydrate with calcium hydroxide and then carefully adding carbon dioxide while keeping the pH of the solution above 7 to prepare the desired product. So specifically teaches that the pH control produces purer product than the stoichiometric method. (So col. 5, lines 11-14.) Bunger as noted above teaches that carbon dioxide should be added at "proper stoichiometric" ration, a high concentration, or so that the solution is between about 9.5 and 9.

Secondly, one skilled in the art would not think of modifying the So et al. reference. In order to combine the references there must a showing of a motivation that is clear and particular. So does not contemplate any purification steps for the starting calcium containing solution. So's process provides a calcium carbonate-carbohydrate complex. So must maintain the calcium and

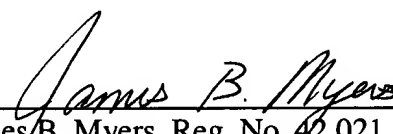
carbon dioxide in solution to form the desired carbonating complex. Consequently, So must maintain the reaction solutions at low temperature and within narrow pH limits while collecting the desired product—the calcium carbonate-carbohydrate complex. Bungler, as in the present invention, is desirous of obtaining a calcium carbonate compound.

The presently claimed invention utilizes impure, waste material containing lime and recycles the waste to provide a pure product of calcium carbonate. The claimed process dissolves the impure lime using a carbohydrate, (preferably sorbitol) and the filters off the insoluble impurities. Carbon dioxide is added to the resulting solution until the pH of the solution is about 7 to induce precipitate a calcium carbonate. The precipitated calcium carbonate is collected as a pure material.

Conclusion

In light of the above discussion, withdrawal of all outstanding rejections and allowance of claims 16, 20-27, and 31 are respectfully requested. In addition, the Examiner is invited to telephone the undersigned attorney if there are any questions about this submission or other matters which may be addressed in that fashion to facilitate allowance of this application.

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